TEMPORARY CARDIAC PACING FOR CMT

Introduction

Pacemakers deliver electrical stimuli via pacing leads to the heart, and can be used on a temporary or permanent basis. Their main function is to treat bradycardia. Wherever possible a permanent system should be inserted (if facilities allow and it is indicated).

Temporary cardiac pacing can be a life-saving procedure and is indicated for treatment until either the underlying cause has resolved or a permanent pacemaker system can be implanted.

For the majority of patients presenting with bradycardia, conservative management is the most appropriate treatment. General indications to consider insertion of a temporary pacing wire (TPW) in the emergency setting are:

1) Syncope at rest
2) Haemodynamically compromised patient secondary to bradycardia
3) Bradycardia induced ventricular arrhythmias (rare)

Sinus node disease very rarely requires temporary pacing

The indications for a TPW can be split into:
1) Emergency setting
2) Usually associated with acute MI
3) Semi-elective setting

There is no consensus on indications form TPW with most recommendations coming from clinical experience rather than clinical trials.

Indications for Temporary Cardiac Pacing Wire Insertion

Acute Myocardial Infarction
Indications for permanent pacing after acute myocardial infarction (AMI) in patients experiencing AV block are related in large measure to the presence of intra-ventricular conduction defects. The criteria for patients with AMI and AV block do not necessarily depend on the presence of symptoms. Furthermore, the requirement for temporary pacing in AMI does not by itself constitute an indication for permanent pacing.

The long-term prognosis for survivors of AMI who have had AV block is related primarily to the extent of myocardial injury and the character of intraventricular conduction disturbances rather than the AV block itself. Despite the use of thrombolytic therapy and primary angioplasty, which have decreased the incidence of AV block in AMI, mortality remains high if AV block occurs. Regardless of whether the infarction is anterior or inferior,

the development of an intraventricular conduction delay reflects extensive myocardial damage rather than an electrical problem in isolation.

Inferior AMI commonly causes complete heart block (CHB), as the right coronary artery frequently supplies the AV nodal artery. This rarely requires a TPW. Any sign of haemodynamic compromise e.g. symptomatic hypotension, poor urine output or a patient becoming cerebrally obtunded would necessitate consideration of TPW insertion. Complete heart block in an acute inferior MI is usually reversible, associated with a narrow QRS complex and may respond to atropine.

Anterior AMI complicated by second or third degree (complete) AV block carries a poor prognosis. The infarct is large and involves the His-Purkinje system. The risk of ventricular asystole is high and a TPW is indicated.

Indications for considering a TPW following an anterior AMI

1) Asystole
2) Second or third degree AV block
3) Bifascicular block (RBBB plus LAD)
4) Trifascicular block (RBBB plus LAD plus first degree AV block OR LBBB plus first degree AV block)
5) Alternating LBBB and RBBB
6) Sinus/junctional bradycardia with inadequate response to atropine
7) Recurrent ventricular tachycardia (overdrive pacing)

Prior to general anaesthetic

The indications for pacing are based on patient symptoms and documented arrhythmias and are made irrespective of the need to undergo surgery. If a query has been raised about the need for pacing prior to surgery the surgery should be postponed until full cardiac assessment can be undertaken via the outpatient clinic. If a patient has a pacing indication then a permanent system rather than a TPW is always the preferred option.

Other indications

1) Heart failure or haemodynamic compromise associated with inappropriate bradycardia unresponsive to atropine
2) Profound bradycardia associated with drug overdose complicated by haemodynamic compromise unresponsive to atropine/isoproterenol
3) Asystole or ventricular standstill
4) Aortic valve or root endocarditis with evidence of AV block
5) Overdrive suppression of bradycardia mediated ventricular tachycardia e.g. torsade de pointes
6) Overdrive termination of recurrent or persistent tachy-arrhythmias e.g. recurrent ventricular tachycardia

Methods Of Temporary Cardiac Pacing

Temporary cardiac pacing can be performed in one of three ways:

1) Non-invasive
2) Transcutaneous (external) ventricular pacing

3) Invasive
    - Epicardial
    - Transvenous

Trans-cutaneous (external) ventricular pacing
This is an emergency measure reserved for the treatment of severe bradycardia or asystole, usually in the setting of a cardiac arrest or peri-arrest situation. It should be considered a temporary measure until more definitive transvenous temporary pacing can be organised. The pacing system is usually incorporated into a defibrillator unit.

Trans-cutaneous ventricular pacing is a non-invasive means of pacing and has a number of advantages when compared to invasive pacing:

1) It can be established quickly
2) It's easy to perform
3) It avoids the risks associated with central venous catheterisation

If time allows remove any excess hair/body fluids to improve electrical conduction. Positioning of the electrodes is usually in the AP configuration, although the antero-lateral position can be used. The patient is likely to require sedation due to pectoral muscle contraction.

Epicardial pacing
Performed by cardiothoracic surgeons. Atrial and ventricular epicardial pacing wires are attached to the pericardium at the time of cardiac surgery. The electrical performance of these leads is poor and they deteriorate over time. Reliable pacing and sensing functions are usually lost within 5-10 days.

Transvenous pacing
The most commonly used pacing mode for the treatment of brady-arrhythmias is ventricular demand pacing. This is achieved with a single bipolar temporary pacing wire inserted in the right ventricle. When it is important to maintain cardiac synchrony e.g. critically ill patients with impaired LV function, dual chamber pacing (atrio-ventricular sequential pacing) is the preferred method as it can improve cardiac output by up to 20%.

General requirements
Placement of a TPW is difficult and must not be attempted by an unsupervised inexperienced operator. ***If in doubt ask for senior help***. Most coronary care units will have a fully equipped temporary pacing room. The operator must be able to obtain central venous access, preferable via the right internal jugular vein. At least one other helper and a radiographer need to be present.

Venous access
Dictated by the clinical setting. If recent thrombolysis has been administered the internal jugular or femoral vein is the route of choice as direct compression can be applied if a haematoma or excessive bleeding occurs. Venous access is secured by the Seldinger technique. A venous sheath is inserted through which a bipolar pacing electrode (wire) can

be introduced. The sheath is usually a French size larger than the pacing wire e.g. 7Fr. This allows drugs to be administered or blood withdrawn from the sheath side arm.
The TPW should not be inserted at the site of any potential permanent pacemaker system (normally the left subclavian/cephalic vein).

Technique
All TPW manipulation must be performed under fluoroscopic guidance. Ventricular temporary leads either have a straight or angulated tip. Ensure that the lead you are handed is designed for ventricular and not atrial pacing.

Once the lead is in the right atrium it is positioned so the tip points towards the cardiac apex (pointing towards the left hip). If the lead will not pass directly through the tricuspid valve, curling the lead within the atrium and withdrawing it slowly, whilst twisting, to flick it through the tricuspid valve may succeed. In the antero-posterior position of fluoroscopic screening the tricuspid valve lies in line with the vertebral bodies.

Transient ventricular arrhythmias, as the TPW passes through the tricuspid valve, are normal. The tip should point downwards in the RV apex.

Once in a stable RV apex position the lead should be advanced to create some “slack” in the wire. This will prevent lead displacement during deep inspiration. If the wire is advanced too forcefully it may puncture the ventricle or ventricular septum.

Checking function
Once positioned connect the TPW to the external pacemaker box, switch to demand pacing, with at least 3 volts output and a rate greater than the patients intrinsic rate. If pacing is successful the heart rate will increase and a LBBB appearance should occur (in septal perforation it is RBBB). Slowly turn the output down until pacing capture is lost i.e. the patients intrinsic rhythm returns. Note this point and then slowly increase the output again until the ventricle is consistently recaptured. This point is known as the “ventricular threshold” and should be less than 1 Volt. Set the output to at least 3x the ventricular threshold to provide a safety margin.

If you do not have ventricular capture ensure the pacing box is turned on and that all connections are correct. If still no ventricular capture is achieved further attempts to reposition the TPW should be made.

Once the TPW has been positioned check stability by asking the patient to take deep breaths and cough whilst monitoring the ECG to ensure consistent ventricular capture (if the patient can comply).

Check wire sensing by turning the pacing rate below the patient‟s intrinsic rate (this is not always possible in the acute setting). Sensing is the ability of the pacemaker to sense an intrinsic electrical signal i.e. “what is seen by the pacemaker”. If the wire is sensing correctly pacing should not occur. Poor sensing requires TPW re-position.

Initiating pacing
The pacing rate (demand rate) should be set as per clinical need. Demand mode means that the TPW will not pace if intrinsic activity is sensed. A low pacing rate is adequate for prophylaxis against bradycardia; a higher rate is needed if the bradycardia is inappropriate e.g. torsade de pointes. The output should be at least 3x times the ventricular threshold and checked at least daily to avoid inadvertent loss of capture. The ventricular threshold will rise after TPW insertion. As the ventricular threshold climbs the output should be reset, always keeping the output 3x times the ventricular threshold. If the ventricular threshold exceeds 5 volts lead replacement is indicated.

High or Rising Ventricular Threshold
1) Check lead connections
2) Check pacing box function and settings
3) Consider lead displacement or perforation through RV wall

Sensing problems
Sensing is important in demand mode. Appropriate sensing setting means the pacemaker will not pace inappropriately over any intrinsic activity. The programmed sensitivity setting indicates the minimum intra-cardiac signal that will be sensed (seen) by the pacemaker to initiate the pacemaker response. When programming sensitivity, as you lower the number you make the pacemaker more sensitive, (allow it to "see" more).

Over sensing
The sensing of events other than P or R-waves by the pacemaker circuitry e.g. muscle contraction.

Over-sensing = Under-pacing

To correct:
Programming a higher number decreases the sensitivity of the device, causing fewer signals to be sensed (seen). In other words "Raise the wall"

Under sensing
Failure of the pacemaker to sense intrinsic P or R waves.

Under-sensing = Inappropriate over-pacing

To correct:
Programming a lower number increases the sensitivity of the device, causing more signals to be sensed (seen). In other words "Lower the wall"

Other considerations
As for any central venous line insertion the TPW needs to be secured in place at the point of venous access.

A CXR must be performed after TPW insertion to exclude a pneumothorax, and to check wire position once the patient has returned to the critical care area.

Pyrexia usually indicates local infection at the insertion site. If infection is suspected, the access site should be swabbed, blood cultures taken, and a fresh TPW inserted

from a separate site. The tip of the infected wire should be sent for culture. Some units advocate the use of prophylactic antibiotics following all TPW insertion e.g. Flucloxacillin 500mgs qds.

Complications of Temporary Cardiac Pacing

1) Complications of vascular access
2) Arterial puncture
3) Bleeding/Haematoma
4) Pneumothorax/Haemothorax
5) Complications of wire insertion
6) Ventricular arrhythmias due to mechanical irritation of RV
7) Septal perforation leading to pericardial effusion/cardiac tamponade and/or pericarditic pain
8) Diaphragmatic pacing
9) Difficulties with wire position
10) Wire displacement: Presents as loss of sensing or pacing.
11) Infection (usually at venous insertion site)

The external generator

Several companies manufacture generator boxes but the basic functions are similar.

Mode

1) **Fixed**: This is the mode used for overdrive pacing. The pacemaker paces at a fixed, constant rate.
2) **Demand**: The generator will not pace if intrinsic activity is sensed. This is the usual pacing mode.

The generator allows adjustment of pacing output, pacing rate, pacing mode, and sensitivity to intrinsic activity. Dual chamber generators will allow greater flexibility in pacing mode and will offer adjustment of atrioventricular delay. Generators may be small enough to allow the patient to be ambulant or need to be placed at the bedside. The generator batteries must be checked at least daily and the generator sited so that it cannot fall and exert traction on the pacing lead.

Some generators may also offer high rate pacing to allow overdrive pacing of tachy-arrhythmias. Activation of this function is usually locked by a key or requires a sliding cover to be removed.

Newer digital temporary generators are usually locked after checking and adjustment to prevent inadvertent changes in programming.

Temporary pacemakers must be checked by competent staff *at least once daily* for pacing thresholds, evidence of infections around venous access sites, integrity of connections, and battery status of the external generator.

Underlying rhythm should also be assessed and recorded at these checks.